WEIGHT SENSOR ACCESSORY

FIELD OF THE INVENTION

The present invention lies in the field of weighing in motion, that is, weighing vehicles when they pass over a weight sensor. It is, however, to be appreciated that a vehicle's speed may be calculated using the apparatus in conjunction with additional vehicle detection means. In particular, the invention relates to a weight sensor, a weight sensor accessory pad, a mould for the weight sensor accessory pad, a weight sensor fitted to the weight sensor accessory pad, a housing for a weight sensor which housing includes a bottom portion analogous to the weight sensor accessory pad, a mould for the housing, and a weight sensor housed within the housing.

BACKGROUND TO THE INVENTION

The term "weighing in motion" refers to weighing vehicles as they pass over a weight sensor. The Inventor is aware of weighing in motion sensors which include a sandwich construction of three electrically conductive sheets, such as aluminium sheets, separated from each other by elastic strips, such as polyurethane (PU) or silicone strips, bonded between the inner sheet and the two outer sheets. A signal from a stable oscillator is applied between the inner sheet on the one hand and the two outer sheets on the other and a circuit measures the change of capacitance which results when a vehicle passes over the sensor. The change in capacitance results from the sheets being compressed together by the weight of a vehicle wheel or wheels on a single axle or axis which may generically be termed an axle set. The change in capacitance is then converted electronically to produce a number related to the weight of the axle.

The dynamic effects of a vehicle passing over a weight sensor at speed are minimised by the weight sensor protruding as little above the

road surface as possible. In circumstances where the weight sensor is placed on top of the road surface this requires the weight sensors to be as thin as possible. In other circumstances, the weight sensor is embedded in the road so that the top of the weight sensor is substantially flush with the surface of the road.

The Inventor has noticed that, regardless of whether the weight sensor is placed on top of the road surface or embedded in the road, water tends to find its way into the weight sensor causing damage to the weight sensor over time which in turn results in inaccurate weight measurements. Such damage is enhanced by the hydro-dynamic movement of the weight sensor in relation to the surface on which it rests due to a film or layer of water between the weight sensor and the surface on which the weight sensor rests.

The Inventor is aware of a woven metallic grid which is placed between the weight sensor and the surface on which the weight sensor rests in order to overcome the damaging effects of water between the weight sensor and the surface on which the weight sensor rests. However, the Inventor has noticed that, over time, the grid is worn down due to the dynamic effects of vehicles passing over the weight sensor causing hydrodynamic erosion, thereby requiring replacement of the grid.

The Inventor has also noticed that when a stone or the like is embedded in a tyre of a vehicle and the weight sensor is used to weigh the vehicle, the stone may also cause damage to the weight sensor.

This invention seeks to ameliorate the damaging effects of water on the weight sensor as well as the damaging effects on the weight sensor of a stone or the like embedded in a tyre of a vehicle being weighed.

In the specification which follows, the word "trapezoid", and variations thereof, is to be understood to mean a four sided geometric figure that has one pair of its opposite sides parallel.

SUMMARY OF THE INVENTION

According to a first aspect of the invention there is provided a weight sensor which includes a grooved lower surface, the grooves being configured to enhance dispersion, in use, of fluids trapped between the weight sensor and a surface on which the weight sensor rests when a downward force is applied to the weight sensor.

The grooves may be configured to form a grid pattern, typically a rectangular grid pattern. The grooves may be configured to form a tread pattern similar to or the same as that of a motor vehicle tyre.

According to a second aspect of the invention there is provided a weight sensor accessory pad for placement or location at the bottom of a weight sensor, the pad including a grooved lower surface, the grooves being configured to enhance dispersion, in use, of fluids trapped between the pad and a surface on which the pad rests when a downward force is applied to the pad.

The pad may include a grooved upper surface, the grooves being configured to enhance dispersion, in use, of fluids trapped between the pad and the bottom of the weight sensor when a downward force is applied to the pad.

The grooves may be configured to form a grid pattern, typically a rectangular grid pattern. The grooves may be configured to form a tread pattern similar to or the same as that of a motor vehicle tyre.

The pad may be shaped and configured to compliment the bottom of the weight sensor. The pad may be shaped and configured for fitment to the bottom of a weight sensor. The pad may be shaped and configured for fluid tight fitment to the bottom of a weight sensor so that fluids are prevented from entering between the pad and the bottom of the weight sensor. The pad may include a rim around the perimeter of the rest of the

pad which rim is shaped and configured for fluid tight fitment of the pad to the bottom of a weight sensor.

The pad may be fitted to the bottom of the weight sensor. The pad may be adhesively bonded to the bottom of a weight sensor. The pad may be fitted to the bottom of the weight sensor by way of securing the rim of the pad around the bottom of the weight sensor.

The rim may be made of an elastic material to facilitate elastic fitment of the rim to the bottom of a weight sensor. The entire pad may be made of an elastic material to facilitate elastic fitment of the rim to the bottom of a weight sensor.

The pad or at least the lower surface of the pad may be made from a material having a relatively high friction co-efficient. The pad may be made from a fluid-impervious material. Typically, the entire pad or at least the lower surface of the pad is made from rubber, polyurethane or the like.

According to a third aspect of the invention there is provided a mould for the weight sensor accessory pad as herein described.

According to a fourth aspect of the invention there is provided a weight sensor having a weight sensor accessory pad, as herein described, fitted thereto.

The pad may be fitted to the bottom of the weight sensor by way of adhesive bonding. The pad may be fitted to the bottom of the weight sensor by way of securing the rim of the pad around the bottom of the weight sensor.

According to a fifth aspect of the invention there is provided a housing for a weight sensor, the housing being made from fluid-impervious material and the housing being shaped and configured to completely enclose the weight sensor in a fluid tight manner.

The housing may be moulded around the weight sensor in a fluid tight manner.

The material from which the housing is made may be resistant to those petrochemicals typically found on a road surface such as oil, petrol, diesel and/or the like. The material from which the housing is made may be resistant to ultraviolet (UV) rays. The material from which the housing is made may be resistant to ozone. The material from which the housing is made may be resistant to those salts typically found on a road surface. The material from which the housing is made may have a relatively high friction co-efficient. Typically, the entire housing is made from rubber, polyurethane or the like. The rubber, polyurethane or the like may be selected and/or treated to enhance its resistance to fluids, petrochemicals, ultraviolet (UV) rays, ozone, salts, and/or the like.

The housing may include a bottom portion analogous to the weight sensor accessory pad herein described.

The housing may include a protective top portion for protecting the weight sensor. The top portion may aid in distributing a downward force applied to the weight sensor. Accordingly, it is to be appreciated that when a stone or the like is embedded in a tyre of a vehicle the top portion reduces the damaging effects of the stone on the weight sensor.

The housing may include a hollow interior, which interior is shaped and configured complimentarily to that of the weight sensor.

The housing may be shaped and configured so that the housing can be fitted into a container for a weight sensor. The container is typically used to embed the weight sensor into a road so that the top of the weight sensor is substantially flush with the surface of the road. The container is typically in the form of a framework into which the housing and the weight sensor are fitted. Accordingly, the exterior of the housing may be planar in

shape and trapezoidal in cross section so that the top portion of the housing has a smaller surface area than the bottom portion of the housing.

According to a sixth aspect of the invention there is provided a mould for the housing herein described.

The mould may be shaped and configured so that the housing can be fitted into a container for a weight sensor. The container is typically used to embed the weight sensor into a road so that the top of the weight sensor is substantially flush with the surface of the road. The container is typically in the form of a framework into which the housing and the weight sensor are fitted. The moulding area within the mould may be planar in shape and trapezoidal in cross section.

The mould may include inserts shaped and configured complimentarily to the grooves in the bottom portion of the housing. The inserts may be in the form of a grid. The grid may form a rectangular grid pattern. The grid may form a grid pattern analogous to a tread pattern similar to or the same as that of a motor vehicle tyre.

The mould may be shaped and configured to receive a weight sensor therein. The mould may include suspension means for suspending a weight sensor in a predetermined position within the mould.

According to a seventh aspect of the invention there is provided a weight sensor housed within the housing herein described.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described, by way of a non-limiting example, with reference to the following diagrammatic drawings, in which:

Figures 1 and 2 show, in side and plan views respectively, a weight sensor;

Figure 3 shows, in side view, a weight sensor aimed at reducing bending of the top sheet at a border region of the top sheet;

Figure 4 shows, in plan, side, and front views, a housing for the weight sensor shown in Figure 3, in accordance with the invention;

Figures 5 and 6 show exploded views of features A and B, respectively, of Figure 4;

Figure 7 shows, in plan, side, front and sectioned front views, a container for a weight sensor housed within the housing shown in Figure 4, in accordance with the invention;

Figure 8 shows, in plan, side, and front views, a mould for the housing shown in Figure 4, in accordance with the invention;

Figure 9 shows an exploded view of feature C of the sectioned front view through line X-X shown in the plan view of Figure 7;

Figure 10 shows a cross section through line Y-Y of Figure 8; and

Figure 11 shows an exploded view of feature D of Figure 10.

DETAILED DESCRIPTION OF THE DRAWINGS

With reference to Figures 1 and 2, reference numeral 10 shows a weight sensor. The weight sensor 10 includes a first electrically conductive sheet 12 electrically isolated from a second electrically conductive sheet 14 by inserts of a closed cell foamed polymeric dielectric 16 and an elastic dielectric 18 in spaces 20 formed between the inserts 16 located between the sheets 12, 14.

The sensor 10 includes a third electrically conductive sheet 22 electrically isolated from the second sheet 14 by inserts of a closed cell foamed polymeric dielectric 16 (shown as shaded areas in the figures) and an elastic dielectric 18 in spaces 20 formed between the inserts 16 located between the second and third sheets 14, 22.

The first sheet 12 has a flat rectangular base 32 and raised border parts 34 proximate a pair of apposing borders of the first sheet 12. The border parts 34 are shaped and dimensioned to receive on top thereof a

pair of apposing border regions 50 of the third flat rectangular sheet 22. The second sheet 14 is a flat rectangular sheet which is sandwiched between the first and third sheets 12, 22. The sheets 12, 14, 22 are aluminium sheets of good conductivity and sufficient strength to ensure a long operational life of the weight sensor.

The inserts 16 are in the form of linear strips analogous to the air gaps in an existing product. The inserts 16 are made from Neoprene (trademark). The closed cells or pores in the inserts 16 contain air which provides a sufficient elasticity for the elastic dielectric 18 to expand laterally displacing the inserts 16 without significantly adversely affecting the favourable elasticity properties of the elastic dielectric 18 for this application.

The elastic dielectric 18 is made from polyurethane (PU).

The sensor 10 includes capacitive measuring means 24, electrically connected between the first sheet 12 and the second sheet 14, which measures a change of capacitance between the sheets 12, 14 when a vehicle passes over the sheets 12, 14. The sensor 10 further includes converting means 26 for converting the change of capacitance to a number related to a weight of the vehicle. It is to be appreciated that, in an alternative embodiment (not shown), the capacitive measuring means 24 is electrically connected between the second sheet 14 and the third sheet 22.

Inner borders 28 and outer borders 30 of the sensor 10 are sealed to make it impervious of entry of water. The outer borders 30 are defined by the zones of contact between the first and third sheets 12, 22 and are sealed with an adhesive resin. As the inner borders 28 are sealed proximate the borders of the second sheet 14 this seal must also be a dielectric so as to electrically isolate the second sheet 14 from the first and third sheets 12, 22. PU is used to facilitate the sealing of the inner borders 28.

Figure 3 shows another embodiment of a weight sensor 10 aimed at reducing bending of the top sheet 22 at border regions 50 of the top sheet 22. It is to be appreciated that, where appropriate in Figure 3, like reference numerals have been used to indicate like or similar features to those shown in Figures 1 and 2.

The weight sensor 10 includes two border parts 52, each extending from a border region 54 of the still lower sheet 12 to a border region 50 of the top sheet 22. Each border part 52 is connected to an upper surface of the top sheet 22 so that the top sheet 22 does not rest on the border parts 52. The border parts 52 are shaped and dimensioned to form a ramp for vehicles to drive on and off the sensor 10, in use, when the sensor 10 is placed top of a road surface.

It is to be appreciated that, as in Figures 1 and 2, the elastic dielectric 18 is configured between the sheets 12, 14, 22 to allow lateral expansion of the elastic dielectric 18 when a downward force is applied to the weight sensor 10 causing the sheets 12, 14, 22 to compress.

It is also to be appreciated that, in another embodiment, the border parts 52 and the still lower sheet 12 may comprise an integral unit.

With reference to Figures 4 to 6, reference numeral 60 generally shows a housing for the weight sensor 10. The housing 60 is made from fluid-impervious material and is shaped and configured to completely enclose the weight sensor 10 in a fluid tight manner.

The housing 60 is typically moulded around the weight sensor 10 in a fluid tight manner. Accordingly, the housing 60 includes a hollow interior, which interior is shaped and configured complimentarily to that of the weight sensor 10.

The material from which the housing 60 is made is resistant to those petrochemicals typically found on a road surface such as oil, petrol,

diesel and/or the like. The material from which the housing 60 is made is also resistant to ultraviolet (UV) rays, ozone, and those salts typically found on a road surface. The material from which the housing 60 is made also has a relatively high friction co-efficient to enhance grip with the surface on which the housing 60 rests. Typically, the housing 60 is made from rubber, polyurethane or the like which has been selected and/or treated to enhance its resistance to fluids, petrochemicals, ultraviolet (UV) rays, ozone, salts, and/or the like.

The housing 60 includes a bottom portion in the form of a weight sensor accessory pad 62. The pad 62 includes a grooved lower surface 64, the grooves 66 being configured to enhance dispersion, in use, of fluids trapped between the pad 62 and a surface on which the pad 62 rests when a downward force is applied to the pad 62. It is to be appreciated that the grooves 66 shown in the plan view diagram are shown in hidden detail as the grooves 66 are located in the lower surface 64 of the pad 62.

In this embodiment of the invention, the grooves 66 are configured to form a rectangular grid pattern orientated at 45° to the edges of pad 62. The grooves 66 have a width of 40 mm and a depth of 5 mm. In other embodiments of the invention, the grooves 66 may be configured to form a tread pattern similar to or the same as that of a motor vehicle tyre.

The housing 60 includes a protective top portion 68 for protecting the weight sensor 10. The top portion is configured to aid in distributing a downward force applied to the weight sensor 10. Accordingly, it is to be appreciated that when a stone or the like is embedded in a tyre of a vehicle the top portion 68 reduces the damaging effects of the stone on the weight sensor 10.

During manufacture, the weight sensor 10 typically is suspended within a mould 70 (shown in Figures 8, 10, and 11) and a liquid form of the material from which the housing 60 is made is poured into the mould 70 where after the material is allowed to set around the weight sensor 10

rendering the weight sensor 10 fluid tight. In this way the housing 60 is fitted around the weight sensor 10 and the hollow interior of the housing 60 is shaped and configured complimentarily to that of the weight sensor 10.

The mould 70 is shaped and configured to receive a weight sensor 10 therein. The mould 70 includes suspension means, in the form of a plurality of hangers 72, for suspending the weight sensor 10 in a predetermined position within the mould 70.

The mould 70 includes inserts (not shown) shaped and configured complimentarily to the grooves 66 in the bottom portion of the housing 60. Accordingly, the inserts are in the form of a grid having a rectangular grid pattern complimentarily to that shown in Figures 4 to 6. In other embodiments of the invention, the grid may form a grid pattern analogous to a tread pattern similar to or the same as that of a motor vehicle tyre.

The mould 70 is shaped and configured so that the housing 60 can be fitted into a container 90 (shown in Figures 7 and 9) for the weight sensor 10. The container 90 is typically used to embed the weight sensor 10 into a road so that the top of the weight sensor 10 is substantially flush with the surface of the road. The container 90 is typically in the form of a framework into which the housing 60 and the weight sensor 10 are fitted. The container 90 includes L-shaped side walls 92 wherein the horizontally extending lower portion 94 of the side walls 92 extends inwardly at the bottom of the container 90. The container 90 is accordingly open-topped and open-bottomed.

In use, a polyurethane (PU) bed 96 is located in the container 90 after the container 90 has been embedded in the road. The housing 60 containing a weight sensor 10 is then placed on top of the bed 96 and a lip member 98 is secured along the inner periphery of the top of the side walls 92 by way of a plurality of downwardly depending rivets, bolts, screws or the like

100 countersunk through the lip member 98 and extending through the horizontally extending lower portion 94 of the side walls 92.

It is to be appreciated that the lip member 98 and the exterior shape of the housing 60 are shaped and dimensioned in a complimentary manner so that the lip member 92 holds the housing 60 down within the container 90. In this embodiment, the housing 60 is planar in shape and trapezoidal in cross section so that so that the outer surface of the top portion 68 of the housing 60 has a smaller surface area than the grooved lower surface 64 of the pad 62. Therefore the lip member 98 is trapezoidal in cross section so as to hold the housing 60 down within the container 90.

Accordingly, it is to be appreciated that the moulding area 74 within the mould 70 is also planar in shape and trapezoidal in cross section.

It is also to be appreciated that the bed 96 defines the surface on which the pad 62 rests. The bed 96 is shaped and configured within the container 90 so as to allow further dispersion of fluids, such as water, which have been dispersed, in use, from between the pad 62 and the surface on which the pad 62 rests when a downward force is applied to the pad 62. Such further dispersion is allowed via the space 102 between the side walls, the bed 96 and the lip member 98 and is drained from the space 102 via a plurality of apertures (not shown) in the horizontally extending lower portion 94 of the side walls 92.

In other embodiments of the invention (not shown), the bottom portion of the housing 60, which is in the form of a weight sensor accessory pad 62, may be provided on its own without the rest of the housing 60. Such pad 62 is then typically placed beneath the weight sensor 10 and may optionally include a grooved upper surface, the grooves being configured to enhance dispersion, in use, of fluids trapped between the pad 62 and the bottom of a weight sensor 10 when a downward force is applied to the pad 62.

Such pad 62 is typically shaped and configured to compliment the bottom of a weight sensor 10. Such pad 62 is typically also shaped and configured for watertight fitment to the bottom of a weight sensor 10 so that fluids are prevented from entering between the pad 62 and the bottom of the weight sensor 10.

Such pad 62 may be adhesively bonded to the bottom of a weight sensor 10. Otherwise, such pad 62 may include a rim around the perimeter of the rest of the pad 62 which rim is shaped and configured for watertight fitment of the pad 62 to the bottom of a weight sensor 10. The rim may be made of an elastic material to facilitate elastic fitment of the rim to the bottom of a weight sensor 10. The entire pad 62 may be made of an elastic material to facilitate elastic fitment of the rim to the bottom of a weight sensor 10.

It is also to be appreciated that the invention extends to a mould (not shown) for the weight sensor accessory pad 62. The invention also extends to a weight sensor 10 fitted to the weight sensor accessory pad 62 herein described. The pad 62 may be fitted to the bottom of the weight sensor 10 by way of adhesive bonding. Otherwise, the pad 62 may be fitted to the bottom of the weight sensor 10 by way securing the rim of the pad 62 around the bottom of the weight sensor 10.

Furthermore, the invention also extends to a weight sensor 10 housed within the housing 60.

In another embodiment of the invention (not shown), the weight sensor 10 may includes a grooved lower surface, the grooves being configured to enhance dispersion, in use, of fluids trapped between the weight sensor 10 and a surface on which the weight sensor 10 rests when a downward force is applied to the weight sensor 10. Accordingly, no pad 62 or housing 60 is necessary to enhance such dispersion of fluids. The grooves may be configured to form a rectangular grid pattern analogous to that of the

housing 60 shown in Figures 4 to 6. The grooves may be configured to form a tread pattern similar to or the same as that of a motor vehicle tyre.

The Inventor regards it as an advantage that the invention ameliorates the damaging effects of water on the weight sensor as well as the damaging effects on the weight sensor of a stone or the like embedded in a tyre of a vehicle being weighed.